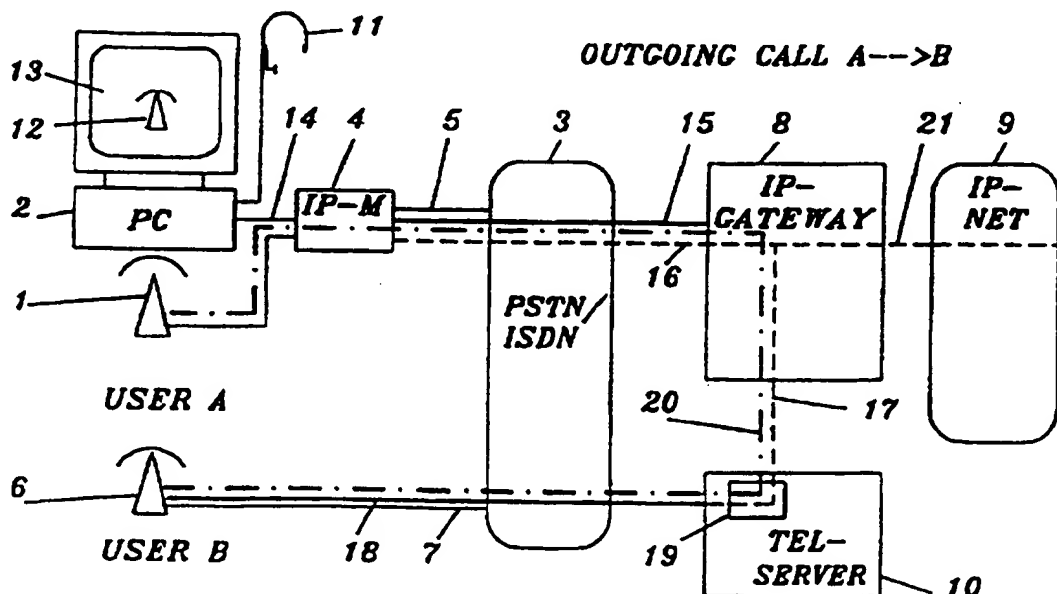




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(54) Title: A MODEM WITH IP SUPPORT



(57) Abstract

The invention relates to a modem (4) with IP support. It comprises access means for autonomous, simultaneous access to the services of a switched telephony network (3) and to the services of an IP based network (9). The autonomous, simultaneous access is established over a dialled up connection (15) and is provided using the IP protocol.

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**TITLE OF THE INVENTION**

A modem with IP support

**TECHNICAL FIELD OF THE INVENTION**

5 The present invention relates to telecommunication in general and to simultaneous voice and data communication using the Internet protocols (IP). In particular the invention relates to a modem which allows access to the PSTN network (or to the ISDN network) and to IP-based networks from the subscriber end  
10 of a subscriber line.

**RELATED ART**

A conventional data modem provides a digital bearer for digital information. A conventional data modem is typically  
15 connected between a computer and a subscriber line. A communication application running on the computer provides access to the Internet over PSTN. The subscriber line will be busy to the PSTN network if the communication application is involved in an ongoing IP session, such as surfing on the  
20 Internet, sending or receiving e-mail, running an IP phone application.

While an application is involved in an IP session it is not possible to make an outgoing call from a normal telephone  
25 connected to the same subscriber line as the modem because the subscriber line is busy.

In reference [1] there is described a telephony server allowing a user, which is involved in an IP session, to  
30 receive telephony calls from the PSTN/ISDN network to a personal computer used for the IP session. An incoming call directed to any member of the user's family can only be handled on the personal computer. It cannot be handled on another telephone device. Likewise another member of the  
35 family than the one engaged in the IP session cannot make an outgoing call over the normal telephone.

A DSVD modem is a modem that allows for digital simultaneous transmission of voice and data on a single line. To achieve this properly a DSVD modem must communicate with another DSVD modem. A DSVD modem comprises means for multiplexing  
5 packetized speech information and for sending the multiplexed information over a single link. A DSVD modem supports two independent sessions such as a telephony session simultaneously with an Internet session but has no means for accessing PSTN/ISDN services in order to establish such  
10 parallel sessions. A DSVD modem does not support the control procedure of analogue phones such as for example control procedures for off hook, on hook, DTMF signalling (dual tone multifrequency signalling), generation of ring signals, generation of ring tones, hook flash signalling.

15

#### **SUMMARY OF THE INVENTION**

One object of the present invention is to provide a modem which allows an outgoing call as well as in incoming call on a normal telephone while simultaneously a communication  
20 application running on a personal computer is involved in an ongoing IP session over the modem.

Still another object of the invention is to provide a modem for autonomous, simultaneous access to the services of a  
25 switched telephony network, such as PSTN or ISDN, and to the services of an IP (Internet Protocol)based network, such as the Internet or an intranet, using the IP protocol.

Still another object of the present invention is to provide a  
30 modem that has at least two analogue telephony interfaces so as to allow a subscriber to have two different telephones which can be operated independently and simultaneously.

Still another object in accordance with the invention is to  
35 provide a modem allowing for internal telephony between a telephony application running on a PC and a normal telephone and allowing for internal telephony between two telephones

connected to the IP modem in a subscriber's home.

A further objective of the invention is to provide a modem that allows connection to a home LAN (local area network in a subscriber's home) using the IP protocol.

Still another objective of the invention is to provide a modem that allows communication with devices, which are connected to the home LAN and which all support communication using the IP protocol, from an IP based network such as the Internet.

The above objects are attained with a modem of the general kind indicated in the attached claims.

The modem in accordance with the invention uses, in an manner known per se, the analogue transport capabilities of an analogue subscriber line to provide a two directional, 28,8 kb/s, or higher, digital transport capability.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of entities involved in an IP-network session among these the modem in accordance with the invention, a telephony server handling an outgoing call to the PSTN/ISDN network,

Figure 2 is a block diagram similar to Figure 1; the telephony server handling an incoming call from the PSTN/ISDN network,

Figure 3 is a block diagram of the general protocol stack used in the modem in accordance with the invention,

Figure 4 is a block diagram showing a specific protocol stack used by the modem in accordance with the invention when a telephony application is running,

Figure 5 is a block diagram of a home LAN (local area

network) served by the modem in accordance with the invention;

Figure 6 is a circuit diagram of a safety feature of the modem in accordance with the invention,

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Figure 7 is a functional block diagram of the modem in accordance with the invention,

Figure 8 is a block diagram of the preferred embodiment of an hardware implementation of the modem in accordance with the invention, and

10

Figure 9 is a functional block diagram of the telephony in server.

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#### **DETAILED DESCRIPTION OF EMBODIMENTS**

In Figure 1 a user A has a telephone 1 and a PC (personal computer) 2 both connected to PSTN/ISDN 3 via a modem 4 in accordance with the invention and via a subscriber line 5.

Another user B has a telephone 6 connected to PSTN via another subscriber line 7.

The modem 4 supports IP and related protocols, such as TCP (Transmission Control Protocols) and UDP (User Datagram Protocol). The modem is placed at the home of subscriber A and will in the following be referred to as an IP modem.

25

In Figure 1 there is also shown a IP gateway 8, an IP based network 9 and a telephony server 10. The IP gateway is connected to PSTN/ISDN 3 and to an IP network 9.

30

The reference PSTN/ISDN 3 refers to networks to which the IP gateway and the telephony server are connected. Examples of such networks are, besides from PSTN (Public Switched Telephony Network) and ISDN (Integrated Services Digital Network), a private telephone network, a PBX (Private Branch Exchange). Examples of an IP network are the Internet and

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intranet. Intranet is based on the technique by which Internet is built and is used for spreading information internally within an organization. Intranet uses IP and related protocols.

5

The telephony server 10 is connected to the IP gateway 8 and to PSTN/ISDN 3. The telephony server provides a telephony service to users of the IP-network. The telephony server is of the kind described in reference [1], contents of which is incorporated herein by reference. To the extent that is necessary for the understanding of the present invention the operation of the telephony server will be described.

The IP-gateway serves as an gateway between PSTN/ISDN and the IP network 9. The IP gateway 8 has physical connections with the PSTN/ISDN, with the telephony server 10 and with IP-network. For the sake of clarity these connections are not shown in Figure 1. Over the connections between the telephony server 10 and PSTN/ISDN speech to and from users is transferred and signalling to and from PSTN/ISDN takes place. The connections between the IP gateway and the telephony server are constant, i.e. they are not established on a per call basis. As an example the telephony server 10 is connected to the IP-gateway via a non shown LAN and to the PSTN/ISDN via an ISDN or PABX line interface. Over the connections between the telephony server and the IP-gateway speech and data information is transported using the IP protocol.

The PC is equipped with a non shown sound card to which audio devices are connected. As an example of audio devices a headset 11 is shown, said headset comprising ear phones and a microphone. In Figure 1 a telephony application 12 is shown by the telephone symbol at a screen 13 of the PC. The telephony application 12 comprises software that runs on the PC. It allows bi-directional voice communication over the sound card and the headset. The telephone application in conjunction with the PC and the sound card converts electrical voice signals

from the microphone into digitized and compressed audio signals that are packetized into IP packets which are sent to the IP modem 4. Conversely the telephony application transforms IP packets containing digitized compressed audio signals into analogue electrical signals which are supplied to the ear phones of the headset. The audio signals supplied to the sound card are processed by the PC and are exchanged with the IP modem via IP protocol driver programs. A cable 14 connects the IP modem with a serial port of the PC.

10

For the moment it is assumed that telephony application is not running on the computer. It is also assumed that the IP modem is switched off.

#### 15 **Activation of the IP modem**

Before the IP modem is used for traffic purposes it is configured with the telephone number to the IP gateway 8 and with user data relating to subscriber A. As an example user data comprises the IP access user name of user A, a password and an IP address to the telephony server:

20

When the IP modem is activated IP functionality residing therein is activated. In order to get a clear understanding of the IP modem functionality reference is made to Figures 1 and 4.

25

When the IP modem is activated: (1) the IP modem makes an outgoing call to the IP gateway. A PSTN/ISDN connection 15 is established. (2) The IP gateway accepts the call. (3) Over an established, non-shown, V.34 connection a PPP (Point to Point Protocol) link is established between the IP modem and the IP gateway. Over the PPP link the IP gateway sets up a IP link 16 to the IP modem. (4) A telephony application resident in the IP modem sends a message to the telephony server telling the telephony server that a telephony application session shall take place for the user telephone number at the IP address of the IP modem. The message is sent in IP packets over one of

35



said constant IP connections. In Figures 1 and 17 this connection is labelled 17. A telephony application can use the services of the PSTN/ISDN network.

- 5 Now the IP modem has registered itself at the IP gateway and the IP gateway is now able to route IP messages which as destination have the IP address of the IP modem 4 to the IP modem. Simultaneously the IP modem is registered at the telephony server, allowing access to PSTN/ISDN services. When  
10 the IP modem is registered at the telephony server one of the existing connections is assigned to the IP modem. The assigned connection is illustrated by an IP link 17.

In the Figures PSTN/ISDN connections are shown by heavy lines,  
15 IP links by dashed lines and speech paths by heavy dashdot lines.

#### Outgoing call

- Next user A wants to make an outgoing call and lifts the  
20 receiver of telephone 1. The IP modem detects this event and sends a dial tone to telephone 1. The IP modem 4 has all hardware required for acting as a conventional line card to user A's telephone. The operations performed by the IP modem in this respect is to provide e.g. off hook, on hook, line  
25 current, dial tone, ring signal, ring tone, hook flash (provided by R-key functionality in some telephony systems), and decoding of DTMF signals from telephone 1. It also has all necessary hardware and software for signalling to the telephony server in order to access the PSTN/ISDN services. In  
30 the following this software is referred to as the IP modem's telephony application.

- Next user A dials the number to user B. The digits are received by the IP modem's telephony application. The IP  
35 modem's telephony application forwards the dialing information to a telephony application resident in the telephony server 10. The telephony server 10 interprets the dialing information

- and makes an outgoing call in the PSTN/ISDN network 3. The PSTN/ISDN network 3 sets up a PSTN/ISDN connection 18 to subscriber B. The PSTN/ISDN network is sending ring signals to subscriber B and the IP modem 4 is sending ring tones to subscriber A. When subscriber B lifts the receiver the PSTN/ISDN network detects this event and reports back to the telephony server 10 which in turn reports back to the IP modem 4. A connection has now been established between A and B.
- 10 When A talks the speech is transferred to the IP modem in the form of analogue signals. The IP modem, in a manner known per se, converts the speech into digital signals. The digitized speech signals are compressed using conventional speech compression algorithms. The digitized compressed speech is
- 15 then packetized, by the IP modem 4, into IP packets which are sent over the IP links 16, 17 to the telephony server 10. The telephony server 10 has a converter 19 which converts received speech packets into isochronous speech signals which are sent over the PSTN/ISDN network to subscriber B.
- 20 When B talks the speech will be transferred to the telephony server 10 as speech signals. The converter 19 converts the speech signals into digitized, compressed information which are sent in IP packets to the IP modem 4 over the IP links 17,
- 25 16. The IP modem receives the IP packets, unpack them and decodes the speech information. Decoded speech signals are sent to the telephone 1. The speech path between A and B is shown by the dashdot line 20.
- 30 Coded speech will occupy only about 10-15 kb/s. The rest of the band width available on said connections can be used for other purposes.
- As will be described further down the IP modem may
- 35 simultaneously with the call to B have another telephone session running.

Simultaneously with the telephone call to B the IP modem may have an ongoing session with the IP network 9 as exemplified by IP link 21. As will be explained later the IP modem has multiplexor/demultiplexor functions that multiplexes  
5 information from different applications onto one and the same IP link to the IP gateway and that demultiplexes received information and forwards the demultiplexed information to their respective destinations. For example the IP modem will forward incoming IP packets from the Internet to an Internet  
10 application running on the PC 2 and will forward incoming packets containing speech information to the telephone 1 via a decoder, decompressor and a d/a converter. IP packets to and from the IP network will pass the IP gateway; they will not reach the telephony server.

15 If user A is running the telephony application 12 on the PC the sound card in the PC will deliver the sound, digitized, compressed and packetized, in IP packets to a PC interface of the IP modem 4. The IP modem 4 will forward them over IP links  
20 16, 17 to the telephony server 10. In this manner user A may use the PC and the headset as a telephone.

#### Incoming call

In this example it is supposed that the IP modem has been  
25 activated and registered its presence at the IP gateway and the telephony server. User A may or may not have an ongoing IP session. For the sake of clarity it is supposed that no IP session is taking place.

30 As mentioned in the previous example the IP modem will, when activated, set up IP link 16, 17 to the IP-gateway and to the telephony server. The IP modem's telephony application will send IP packets to a telephony application running in the telephony server. Among these there is one containing a  
35 message requesting the telephony server to activate the service "call forwarding" in the PSTN/ISDN network. Other means to request the call forwarding service are described in

reference [1]. On behalf of user A the telephony server 10 requests call forwarding service in the PSTN/ISDN network and indicates as call forwarding number, i.e. the number to which calls directed to A shall be forwarded, a telephone number of the telephony server 10. When the call forwarding service has been completed a call to user A's telephone number will be routed by the PSTN/ISDN network to the telephony server 10.

User B wants to speak with user A over the telephone and dials the telephone number to user A. PSTN/ISDN detects that calls to A should be forwarded to the telephony server. A PSTN/ISDN connection 22 to the telephony server is established. The telephony server receives the call and notes it is directed to user A. Using the above mentioned registration data of A, said registration data comprising A's telephone number and A's IP address, the telephony server creates a relation between the incoming call and the IP modem's IP address. Various methods to accomplish this are described in reference [1]. Next the telephony server sends IP packets to the IP modem over the IP links 17, 16; said IP packets comprising an alert message.

The IP modem receives the alert message and generates in response thereto a ring signal on A's telephone.

When A lifts the receiver the IP modem detects this event and sends a corresponding message in IP packets to the telephony server. A connection has now been established between B and A. Speech signals are sent from B to the telephony server over the PSTN/ISDN connection 22. In the telephony server converter 19 converts the speech signals into digitized compressed signals which are packetized in IP packets which are sent from the telephony server to the IP modem over the IP links 17, 16. In the IP modem the received IP packets are unpacketized, decompressed and converted into speech signals which are sent to the telephone 1. B and A can now have a conversation. The speech path is shown by the dashdot line 20 in Figure 2.

If A does not answer the call the IP modem 4 takes no action. The telephony server continues to send ring tones to subscriber B. When B places the receiver in the cradle of the telephone 6 this event detected by the PSTN/ISDN which  
5 releases the connection between 6 and 10.

Instead of generating a ring signal upon reception of the alert message the IP modem itself may generate an audible signal or may send an alert message to the PC which then  
10 displays an alert message on the screen of the monitor 13.

Instead of answering the call user A may decide to redirect the incoming call to a call handler as described in reference [1].

15

When the conversation between A and B is finished the PSTN/ISDN connection 22 and the speech path 20 is released. The telephony server 10 releases the relation between the incoming call and A's IP address. The PSTN/ISDN connection 15  
20 remains.

To establish the correct relation between an incoming call and the called user the telephony server must be given the destination of the incoming call from the incoming call  
25 itself. Several methods for achieving this are described in reference [1].

If user B makes a call to user A and user B also has an IP modem, then the call will be treated as a combination of an  
30 outgoing call with an incoming call.

In Figure 3 various protocols used by the IP modem are shown. In the IP modem there is one protocol stack per access type. Thus there is one protocol stack 23 for access to the  
35 subscriber line, one protocol stack 24 for access to the telephone or telephones and one 25 for access to the PC.

The telephone protocol stack 24 comprises as the lowest layer POTS (Plain Old Telephony Services) access "protocol" 26. If the subscriber has two telephone accesses, i.e. there are two telephones connected to different loops, then there is another  
5 POTS access "protocol" 27, as indicated by the dashed line. Over the POTS access layers there is a layer comprising coding/decoding 28, labelled CODEC, and control 29 of signals exchanged between the POTS layer and the uppermost telephony application layer. The IP modem's telephony application 30  
10 provides i.a. functions for handling incoming and outgoing calls, functions for operating the specific telephone type used, and functions for transfer of signals between the telephone(s) and the PSTN/ISDN.

15 The subscriber line protocol stack 23 comprises, a bottom POTS layer 31, over the POTS layer a V.34 protocol layer 32 providing i.a. common data exchange functions, over the V.34 layer a PPP (Point to Point Protocol) protocol layer 33, over this an IP (Internet Protocol) layer 34, over the IP layer an  
20 UDP/TCP layer 35 (User Datagram Protocol and Transmission Control Protocol respectively) and over the UDP/TCP layer the telephony application layer. The UDP protocol is used for voice transmission and the TCP protocol for signalling between the telephony application layer and the IP layer. The  
25 telephony application layer 30 is the uppermost protocol layer of the subscriber line protocol stack and is common to the subscriber line protocol stack and the telephone protocol stack.

30 For the sake of clarity the control means by which a V.34 connection is established are not shown in Figure 4. Such control means are resident in the IP modem.

As will be explained below there may be other applications  
35 running in the IP modem. Such other applications are at the same protocol layer level as the telephony application layer and uses one or more of the underlying UDP/TCP, IP, PPP, V.34

and POTS protocols depending on the specific application. In Figure 3 one such other application is shown at 36.

5 The PC protocol stack comprises, from the bottom, a serial port interface layer 37, a PPP protocol layer 38 and as uppermost layer the IP protocol layer 34.

Figure 4 illustrates how the protocols shown in Figure 3 are used by the IP modem's telephony application 30 for  
10 communication with the IP gateway and the telephony server. In the IP modem the telephone protocol stack 24 and the subscriber line protocol stack 23 are used. In the IP gateway a protocol stack 39 is used for access to PSTN/ISDN and in the telephony server a protocol stack 40 is used for access to the  
15 IP gateway. The telephony server also has a non shown protocol stack, similar to the subscriber line protocol stack, for access to PSTN/ISDN. The latter protocol stack is not shown in order not to destroy the clearness of Figure 4.

20 The lowest protocol layer of protocol stack 24 is the POTS layer 26 which in this case is an analogue access interface providing communication in PSTN/ISDN. Over the POTS layer is CODEC 28 and CONTROL 29 layers. Over this latter layer is the telephony application 30.

25

The lowest protocol layer of structure 23 is POTS layer 31 providing communication in PSTN/ISDN. Over the POTS layer 31 is the V.34 protocol layer providing a raw digital link on the PSTN/ISDN connection 15. Over the V.34 protocol layer there  
30 is the PPP protocol layer 33 allowing for transmission of IP packets. Over the PPP layer is the IP protocol layer 34 allowing for handling of IP addresses. Over the IP layer is the TCP/UDP protocol layer 35. In the IP modem the POTS access protocol layer and the V.34 protocol layer are handled by a  
35 standard data modem 41, the PPP protocol layer by a PPP handler 42, the IP protocol layer by an IP handler 43 and the TCP/UDP protocol layer by a TCP/UDP handler 44. Each one of

the handlers 41, 42, 43 comprises software of known art.

The IP gateway protocol stack 39 for access to the PSTN/ISDN network comprises, from the bottom, a POTS protocol layer 45, a V.34 protocol layer 46, a PPP protocol layer 47 and an IP protocol layer 48. The POTS and V.34 protocol layers are handled by a modem pool 49, the PPP layer by a PPP handler 50 and the IP layer by an IP handler 51. The IP gateway has also a non shown protocol stack for access to the non shown constant IP connections to the telephony server. This non shown protocol stack has an IP protocol layer which it shares with IP protocol layer 48.

The telephony server protocol stack 40 comprises, from the bottom, an IP protocol layer 53 and a UDP protocol layer 54. In the telephony server these layers are handled by a PPP handler, an IP handler and an UDP handler respectively. The IP protocol layer 53 is carried by a non shown LAN interface.

The IP modem's telephony application 30 communicates with an telephony application 55 in the telephony server using the UDP protocol and the TCP protocol. Such communication is indicated by the double headed arrow 56.

As indicated above the IP modem also may have one or more other applications 36 which communicate with other similar applications using the TCP protocol layer. An example of an other application is an e-mail poller, polling the e-mail boxes user A may have in the IP network 9. When there is mail in a mailbox an indication is given, for example a visual indication. Another example of an application is remote handling of consumer devices, such as an electricity consumption meter. Other examples will be given below with reference to Figure 5.

35

In Figure 5 there is shown how the IP modem 4 in accordance with the invention is used to provide internal communication



between two different loops to which user A has telephones connected. One loop is labelled 57 and another loop is labelled 58. Several telephones may be connected to loop. In Figure 5 one telephone 1 is shown to be connected to loop 57 and one telephone 59 is connected to loop 58. Each loop is connected to a respective physical port to the IP modem. Each port is operated by the telephony application 30. A telephone connected to loop 57 can therefore communicate with a telephone connected to loop 58. In the example shown telephones 1 and 59 can communicate with each other. In this way intercom is provided by the IP modem. This is illustrated by double headed arrow 60.

In accordance with the invention the IP modem 4 has a LAN application and therefore serves as a simple router of a home LAN 61 to which different devices are connected. Each connected device supports the TCP/IP protocol, in other words they "speak" IP, and can therefore communicate with other devices, remote from the LAN, provided said other devices also support communication using the TCP/IP protocol.

In particular the telephony application 12 running on the PC can communicate with any of the two telephones 1, 59 via the IP modem. This is illustrated by the two double headed arrows 62, 63. Intercom is thus provided between the headset 11 and any of the telephones 1, 59.

To the home LAN 61 an electricity consumption meter 64, a water consumption meter 65, a smoke and fire detector 66, a stove 67 with an oven 68 are connected. This configuration allows remote handling, such as read out, of the electricity and water consumption meters. When the smoke and fire detector detects smoke an alarm telephone number, for example to a SOS alarm center or to the fire brigade, is automatically dialled by the IP modem. With this configuration it will also be possible to remote operate the stove as well as the oven, e.g. from a PC with access to the IP network.

It goes without saying that the IP modem 4 supports a number of features to enhance traditional telephony such as abbreviated dialing numbers. An abbreviated dialing number may  
5 include an IP address for an address which can be reached by IP phone.

#### Basic telephone

The IP modem 4 operates into different modes depending on user  
10 A's desires and depending on the kind of services required by A. The IP-network and PSTN/ISDN network services available from the IP modem have been described in connection with Figures 1-5. In Figure 6 the basic telephony service is shown. The IP modem 4 comprises a relay 69 with two moveable contacts  
15 70, 71. Contact 70 is adapted to be connected the wall socket in A's premises and from there to the subscriber line to the local office. Contact 71 is adapted for connection to user A's telephone loop 57. Each moveable contact can move between two stationary contacts, two of which are interconnected by a  
20 cable 72. When the moveable contacts are in the position shown in Figure 5 basic telephony mode is provided. When the moveable contacts are in their opposite positions the IP mode described in connection with Figures 1-5 is provided. In the position shown in Figure 6 a telephone connection is hard  
25 wired through the IP modem. In this position A's telephone apparatus will be connected, usually via a non shown wall socket, to the subscriber line. When main power is down the default mode of the IP modem will thus be basic voice telephony. Basic voice telephony mode can also be manually  
30 selected by user A, for example by flipping a non-shown switch on the IP modem.

In Figure 7 a functional block diagram of the IP modem 4 is shown. It comprises a PC interface 73/72 providing a serial  
35 interface using the IP and PPP protocol layers 34, 38. Thus the PC interface supports exchange of IP packets. Instead of the serial PC interface 73 there may be a LAN interface 74

shown by dotted lines.

There is also one telephone interface 75 for connection to loop 57, one telephone interface 76 for connection to loop 58 and one subscriber line interface 77 for connection to the analogue subscriber line. The telephone interfaces are enhanced with capabilities to detect control signals from a telephone, such as off hook, on hook, hook flash signals, DFTM signals and to generate ring signals, dial tones and other acoustic signals. The telephone interfaces convert the speech into digital signals which are compressed, for example using GSM compression, packetized and put into IP packets. Incoming IP packets which carries speech are processed in the reversed way. It should be noted that the safety device provided by items 70, 71, 72 supports one telephone interface only, for example telephony interface 75. The subscriber line interface 77 further comprises standard data modem capabilities to provide for a bi-directional 28,8 kB/s or higher digital transport capability.

There is also one or more application handlers 78, 79. In one of them, for example 78, said other application 36, for example the e-mail polling application, is residing. In the other, other applications are residing, for example applications which provide functionality required to operate devices attached to the IP modem by way of the LAN 61. An exemplary such other application is one that switches the oven off when the smoke detector detects smoke.

There is also an IP MUX/DMUX functionality 80, also referred to as IP router functionality, which takes IP packets from the different interfaces and sends them in proper order to the subscriber line interface 77. The IP MUX/DMUX functionality also provides for reception of IP packets from the subscriber line interface and for delivery of the received IP packets to their proper interfaces. Finally there is an overall control functionality 81 for controlling the operation of the IP

modem's various functionality's.

#### Local mode

When power to the IP modem is on and the modem has no  
5 connection to the IP network 9 the modem is said to be in its  
local mode.

If the IP modem is in its local mode intercom is possible  
using the telephony application 30. The intercom possible in  
10 the local mode is exemplified by arrow 60 in Figure 5,

In the local mode of the IP modem other applications 36 can  
run on the home LAN. As an example the above mentioned  
application that switches the oven off when smoke is detected  
15 may be running on the LAN. In the local mode one such other  
application 36, not necessarily anyone of those exemplified  
above, can instruct the IP modem to set up a connection to the  
IP network 9. As an example the e-mail polling application can  
check if there is any e-mail to user A in a mail box. The mail  
20 box is resident in the IP network. To check this the IP modem  
makes a call to the IP gateway. When the connection has been  
established the e-mail polling application sends an IP poll to  
the mail box and communicates with it using IP. Such a call  
may for example be made at regular intervals.

25

In the local mode of the IP modem an external application,  
i.e. an application running on a communication device outside  
of user A's home, can establish communication with an other  
application 36 in user A's IP modem 4. As an example a mail  
30 box in the IP network 9 can request an IP gateway to call the  
IP modem 4 in order to deliver mail for user A. Another  
example is an external application that reads the electricity  
consumption meter 64 from a remote site. Upon reception of a  
call from an external application the IP modem identifies the  
35 caller, based on e.g. number identification, and as a result  
of the identification the call is accepted or rejected. Is the  
call from a valid IP session initiator the call is accepted,

otherwise it is rejected. Is the call accepted the IP modem enters connected state mode and starts an IP session with the external application. Connected state mode implies that the IP modem is connected and communicates over the IP protocol layer. If the call is rejected the IP modem remains in the local mode.

In Figure 8 there is shown a physical implementation of the IP modem 4. The control functionality 81 is implemented by a microprocessor. Hardware and/or software is added for speech encoding, e.g. GSM encoding. Likewise software for driving telephone interface 75 is added to a non shown memory unit that communicates with the CPU. In a preferred embodiment of the invention the standard modem 41 and the coding/decoding provided by the subscriber line interface 77 are implemented using DSP:s (Digital Signal Processors).

The IP MUX/DMUX function 80 is provided by the microprocessor.

The telephony server 10 shown in Figure 9. comprises a central controller 82, an access handler 83, a compression and packetizing unit 84, an IP handler 85, PSTN/ISDN lines 86 connected to the PSTN/ISDN network and a number of lines 87 connected to the IP-gateway 8. Under control from the central controller 82 the access handler receives incoming calls, places outgoing calls, handles the telephone numbers of the IP modem, requests the PSTN/ISDN network to activate and deactivate the call forwarding service and provides connections to the IP gateway 8. The compression and packetizing unit converts the speech signals into digital format, and vice versa, so that they can be subjected to digital processing. Digitized speech signals are sampled using conventional sampling technique and are subjected to compression using a conventional speech compression algorithm. Finally the sampled compressed digital signals are organized into packets and sent to the IP handler 85 which provides the packets with address and tails so as to form IP packets. The

IP handler 85 also controls the flow of IP packets to and from the IP gateway. The IP handler handles the IP layer 53 in Figure 4.

- 5 The lines 86, 87 are preferably digital lines such as ISDN 30B+D (primary rate B) or a digital PABX line (Private Automatic Branch Telephone Exchange). To the telephony server 10 it does not matter whether the telephones 1, 6, 59 are of analogue or digital type because PSTN/ISDN 3 will provide the proper type of signals to the telephones. The telephony server must, however, depacketize the compressed speech and decompress it before it is sent as normal speech information to the PSTN or the ISDN network.

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15 **References:**

- [1] Our co-pending Swedish patent application 9602212-4 filed on June 4, 1996

## CLAIMS

1. A modem characterized in that it comprises access means  
(30, 41-44, 73-75, 77) for autonomous, simultaneous access to  
the services of a switched telephony network (3) and to the  
5 services of an IP based network (9), said autonomous,  
simultaneous access being established over a dialled up  
connection (15) and being provided using the IP protocol.
2. A modem in accordance with claim 1 characterized in that  
10 said telephony network (3) an analogue or digital public or  
private telephony network.
3. A modem in accordance with claim 2 characterized in that  
said IP based network (9) is a public or private network.  
15
4. A modem in accordance with claim 3 wherein said access  
means comprises a telephone interface (75) for connection to  
telephones (1), a PC interface (73) for connection to a PC, a  
subscriber line interface (77) for connection to a subscriber  
20 line, characterized in that said telephone interface (75)  
provides telephony using the IP protocol.
5. A modem in accordance with claim 4 characterized in that it  
comprises means (75) for detecting and generating control  
25 signals for a telephone and for transmission of voice  
information to said telephones (1).
6. A modem in accordance with claim 4 characterized in that  
said PC interface (73) in a manner known per se provides data  
30 exchange using the IP protocol.
7. A modem in accordance with claim 4 characterized in that  
said access means further comprises an IP handler (43) for  
autonomously providing access to an IP gateway (8) and to a  
35 telephony server (10), said telephony server being connected  
to said switched network, said IP gateway being connected to  
the telephony server and, in a manner known per se, to the

switched network as well as to said IP based network.

8. A modem in accordance with claim 9 characterized in that said access means further comprises a LAN interface (74) for connection to a LAN (61), thus providing access to devices (2, 64-68) with IP communication capabilities.

9. A modem in accordance with claim 4 characterized in that it comprises a number of applications (30, 36) each of which is supported by communication in said IP based network.

10. A modem in accordance with claim 4 characterized in that it further comprises multiplexer/demultiplexer means (80) for multiplexing of voice and data signals to be transmitted on said dialled up connection (15) and for demultiplexing voice and data signals received on said dialled up connection and for directing said demultiplexed signals to the telephony interface (75) and to the PC interface (73) respectively.

11. A modem in accordance with claim 4 characterized in that it comprises at least two telephone interfaces (75, 76) each one connected to a respective telephone loop (57, 58) so as to allow for several independent and simultaneous telephone calls.

12. A modem in accordance with claim 11 characterized in that intercommunication (60) is provided between telephones connected to different telephone interfaces.

13. A modem in accordance with claim 11 characterized in that intercommunication (63) is provided between a telephony application (13) running on a PC (2) connected to said PC interface (73) or said LAN interface (74) and any one of the telephones connected to the different telephone interfaces.



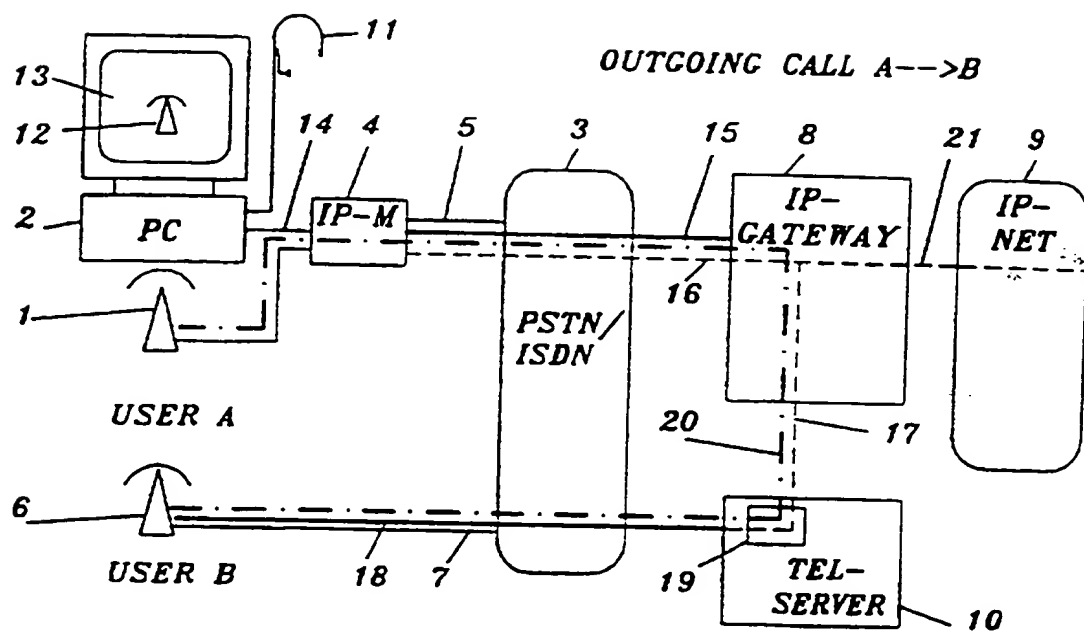


FIG. 1

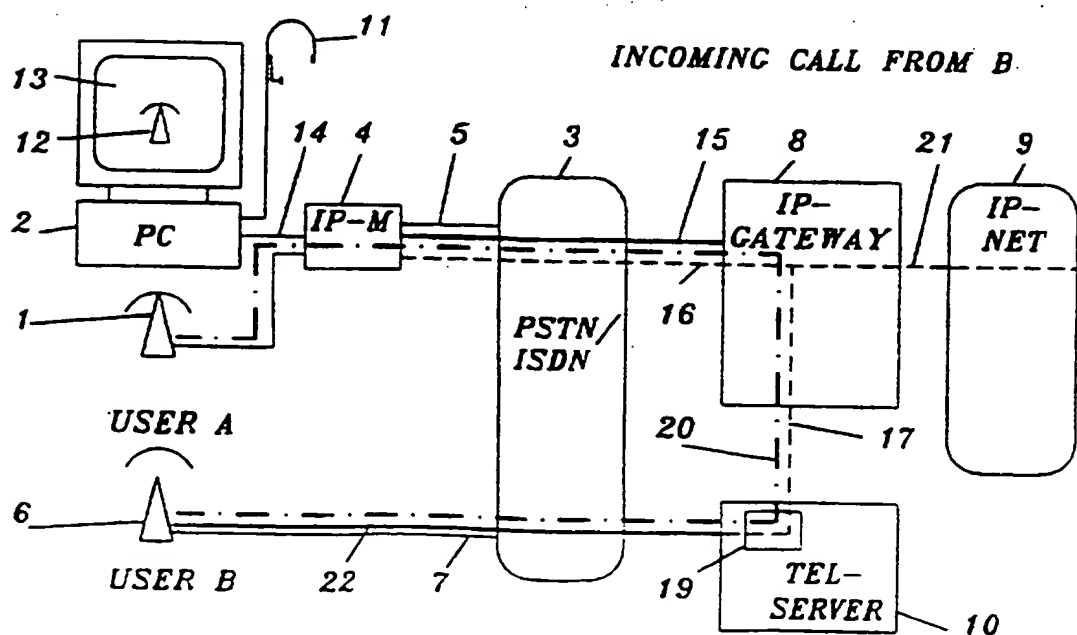


FIG. 2

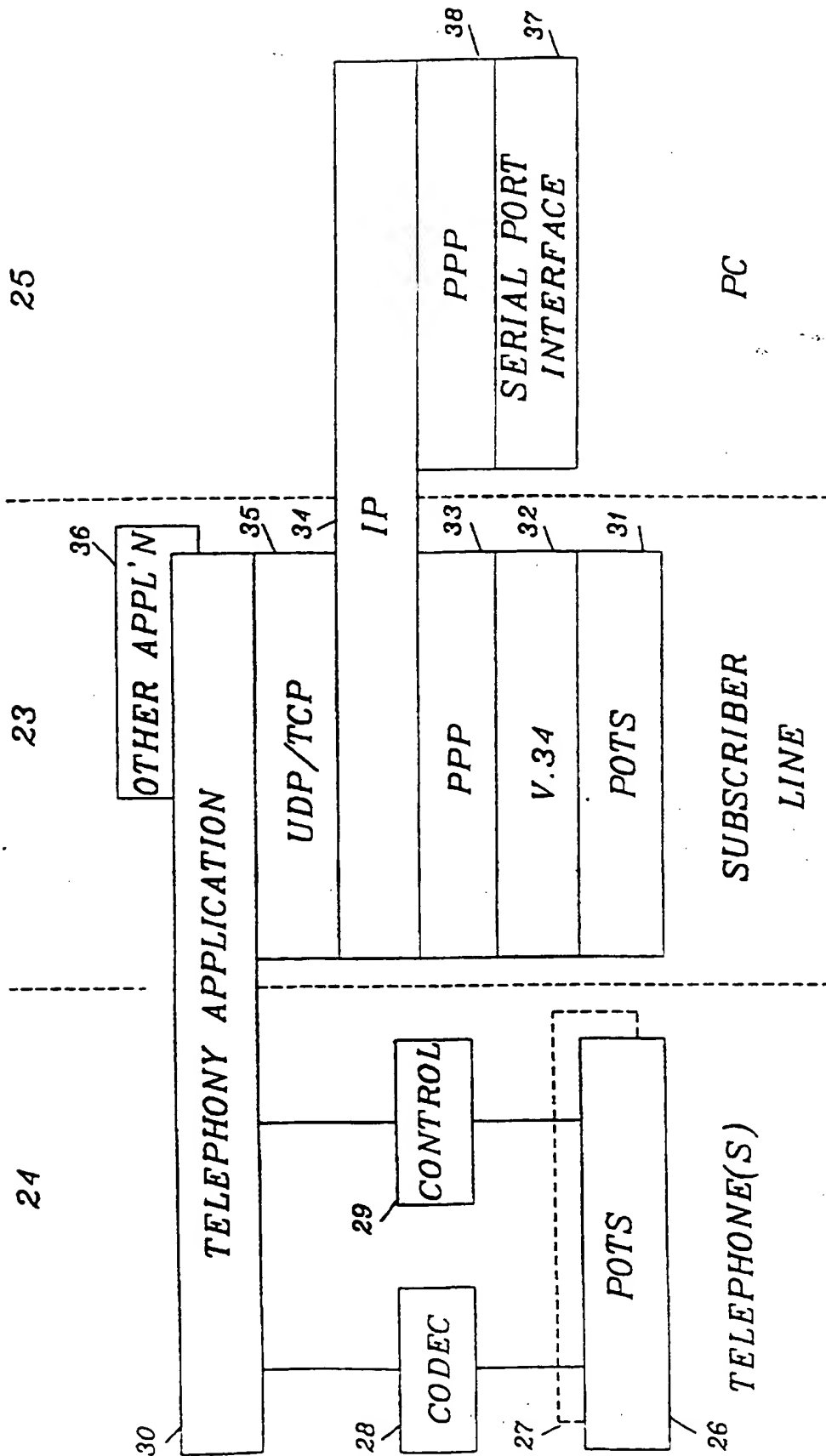


FIG. 3

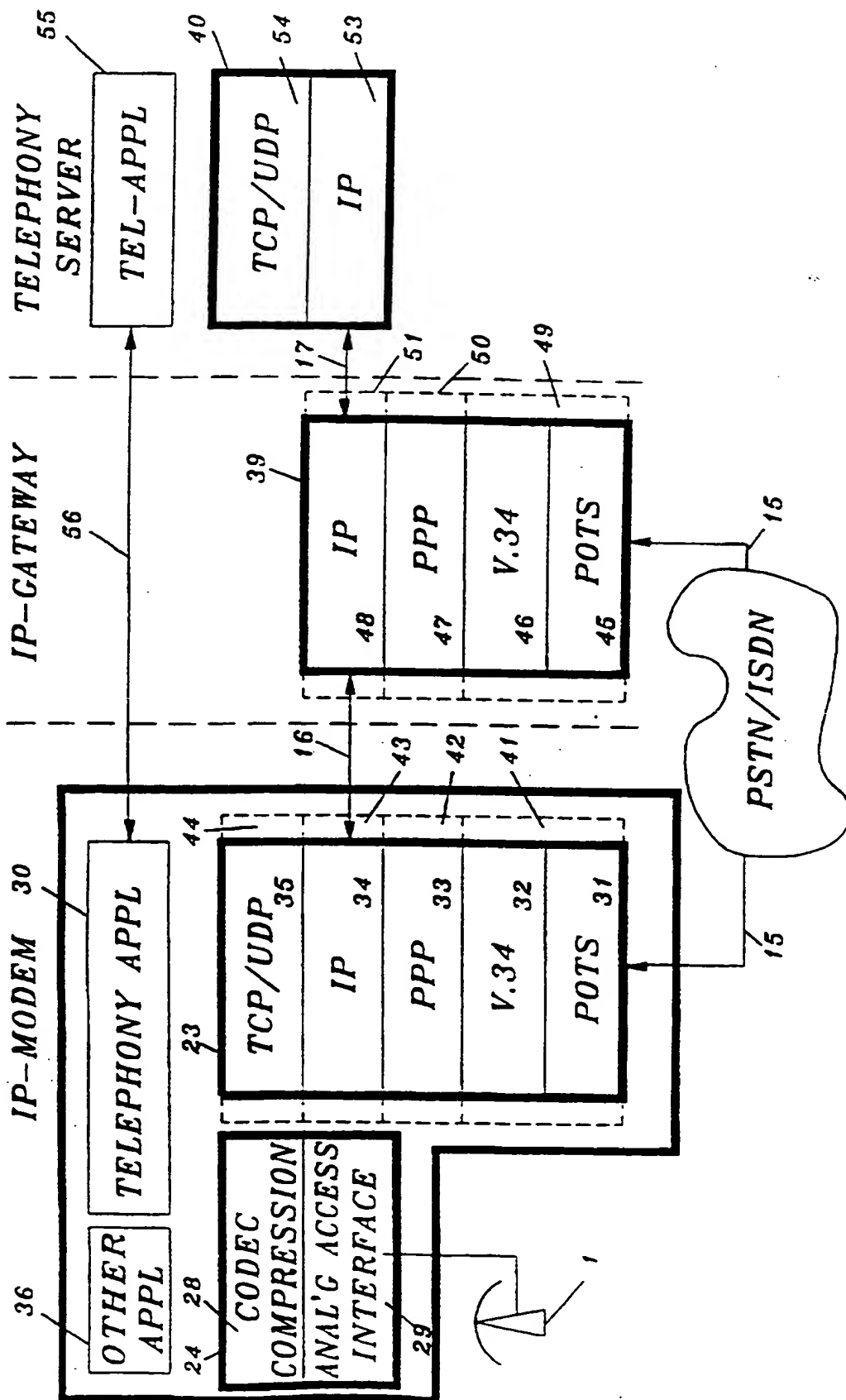
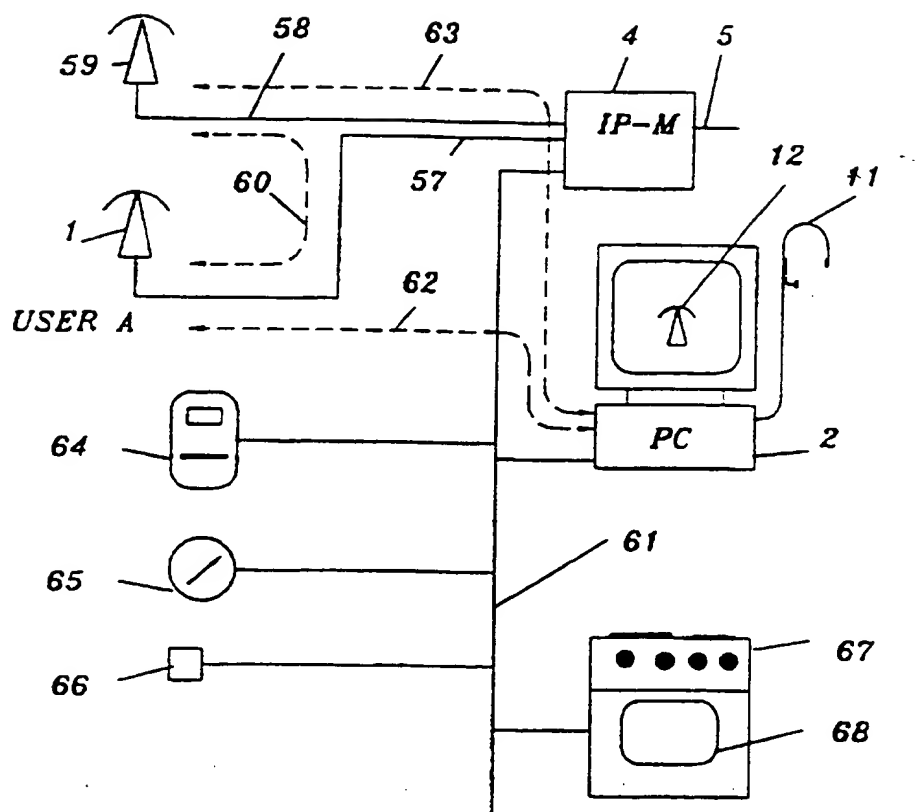
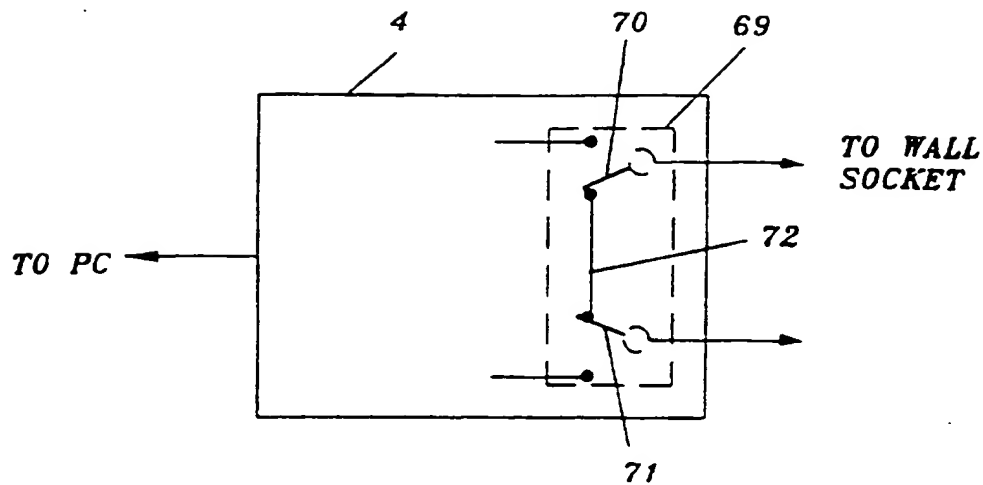
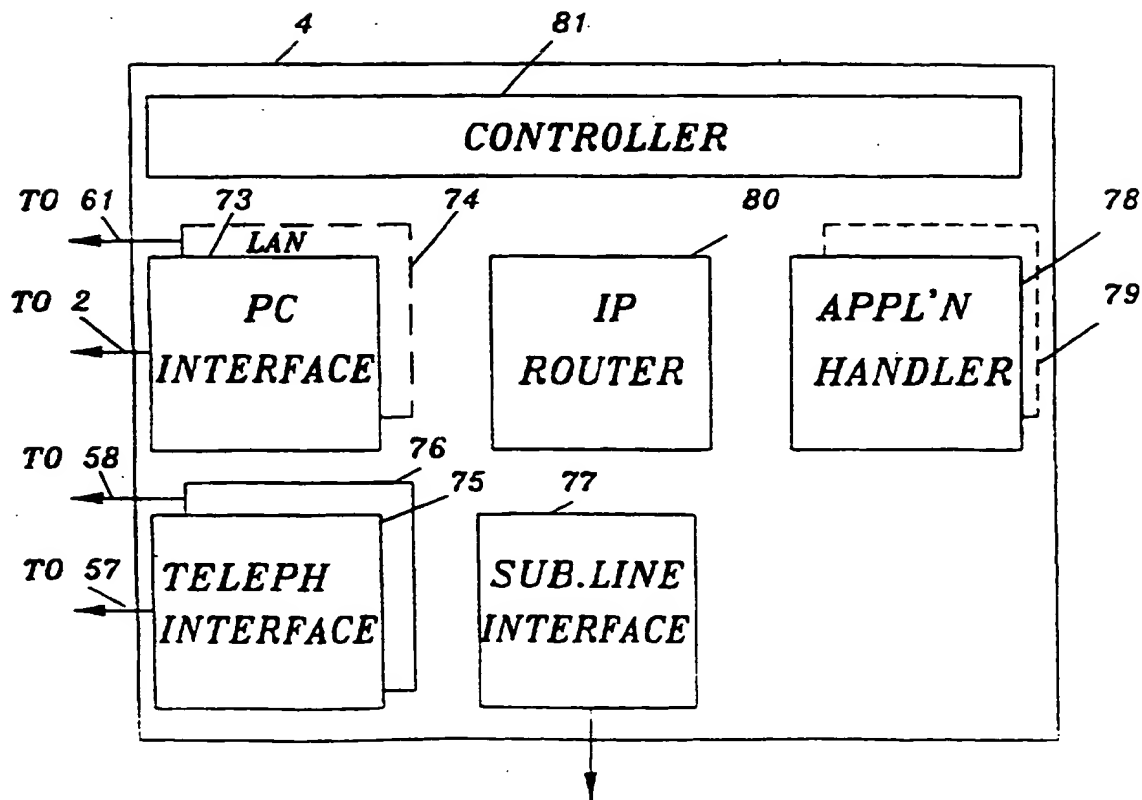


FIG. 4

*FIG. 5*

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*FIG. 6**FIG. 7*

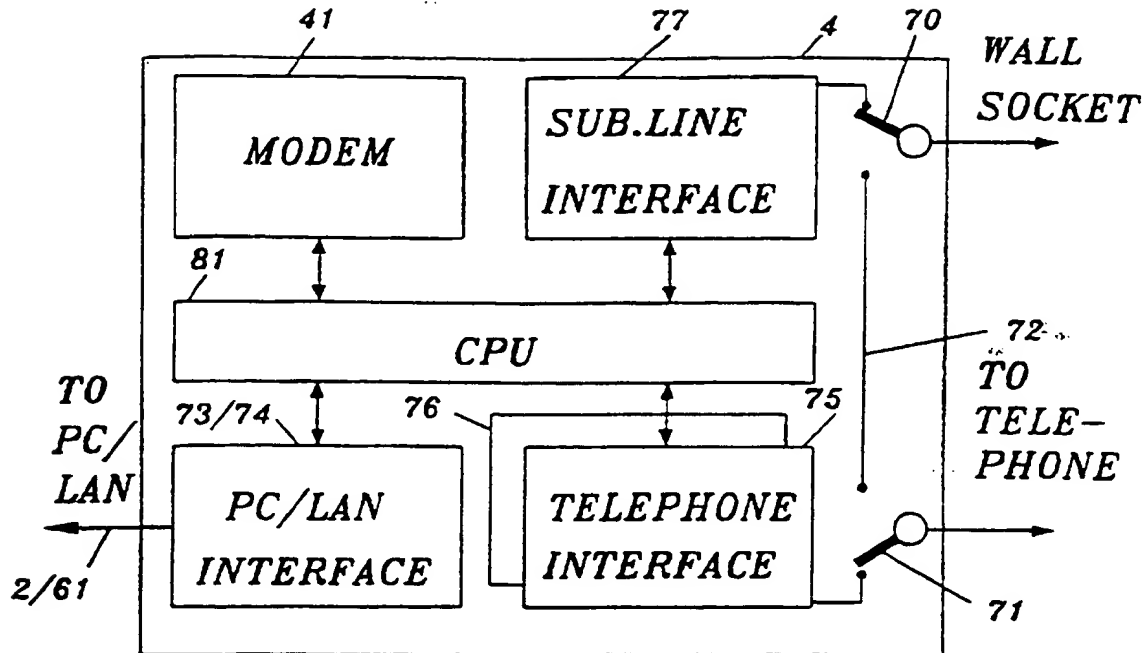


FIG. 8

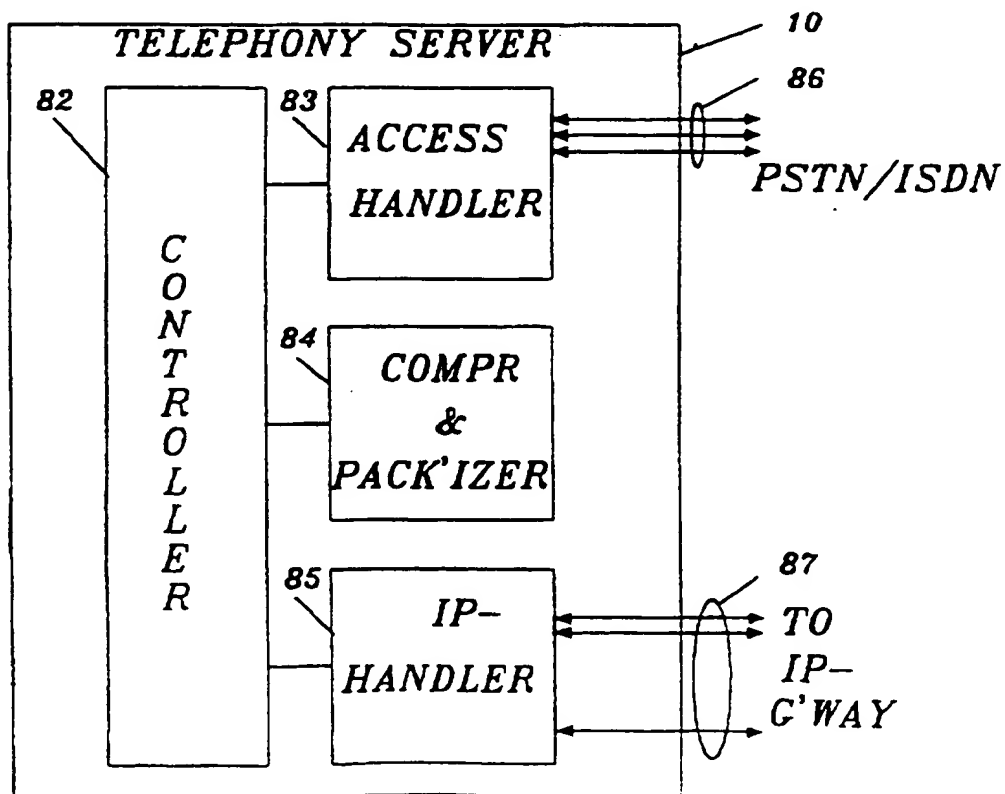


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00968

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04M 11/06

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04M, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	--	4-13
Y	US 5513251 A (ROCHKIND ET AL), 30 April 1996 (30.04.96), column 3, line 42 - column 5, line 16, figure 1	4-13
P,Y	WO 9620553 A2 (ALPHANET TELECOM INC.), 4 July 1996 (04.07.96), page 2, line 31 - page 4, line 4	4-13
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

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Date of the actual completion of the international search

27 October 1997

Date of mailing of the international search report

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00968

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0676886 A2 (AT & T CORP.), 11 October 1995 (11.10.95), abstract  --	1-13
P,A	US 5625677 A (FEIERTAG ET AL), 29 April 1997 (29.04.97), column 1, line 10 - column 2, line 49	1-13
P,A	EP 0777364 A2 (TELEFONICA DE ESPANA, S.A.), 4 June 1997 (04.06.97), column 11, line 36 - column 13, line 4, figure 1  -----	1-13



**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

01/10/97

International application No.

PCT/SE 97/00968

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